Résumé de thèse

Biology, population dynamics, management and conservation of deep water lantern sharks, *Etmopterus spinax* **and** *Etmopterus pusillus* **(Chondrichthyes: Etmopteridae) in southern Portugal (northeast Atlantic)**, by Rui COELHO (1).

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Deep water sharks are particularly vulnerable to fishing mortality with population collapses occurring even at low levels of fishing. Two lantern sharks species, *Etmopterus spinax* and *E. pusillus,* are commonly caught as by-catch in commercial fisheries that operate in southern Portuguese waters and, due to their null or low commercial value, they are usually discarded at sea. Little is known about the biology and population dynamics of these two lantern shark species or on how fisheries are impacting these populations. The present study focused on several aspects of these species, including fisheries, morphology, life history, distribution patterns and population dynamics. Data regarding by-catch of these species from commercial fisheries was presented, with regards to size, maturity and sex ratio distributions. Trawls generally caught smaller sized specimens, in a wider length range than longlines. Trawls caught mostly immature *E. pusillus* (83.7%) and *E. spinax* (84.3%), while longlines caught mostly immature *E. pusillus* (69.2%) and mature *E. spinax* (88.2%). Both trawl and longline caught more male than female *E. pusillus* while both gears caught more female than male *E. spinax*. Given the relative difficulty in separating deep water lantern sharks, multivariate analysis was used to efficiently separate these two very similar and easily mistakable species. For this, the morphometric traits of the two species were studied using 27 different morphological measurements, and these were processed with multivariate analysis in order to find out the most important ones likely to separate the two species. Life history parameters, specifically age, growth, fecundity, maturity and reproductive seasonality were determined. On both species, age was estimated from sections of the 2nd dorsal spine and validated by marginal increment analysis. *E. pusillus* males attained a maximum age of 13 yr while 17 yr old females were found. *E. spinax* males attained a maximum age of 8 yr while 11 yr old females were found. Several growth models were fitted on both size and weight at age data, showing that even though these are small sized species they have relatively slow growth rates. Both species mature late and at a relatively large size: *E. pusillus* matures at 86.8% (38.0 cm) and 79.4% (43.6 cm) of the maximum observed sizes and at 58.0% (7.1 yr) and 54.4% (9.9 yr) of the maximum observed ages for males and females respectively. *E. spinax* matures at 76.5% (25.9 cm) and 74.7% (30.7 cm) of the maximum observed sizes and at 49.6% (3.9 yr) and 42.5% (4.7 yr) of the maximum observed ages for males and females respectively. Both species have a relatively low fecundity, specifically 10.44 oocytes per reproductive cycle for *E. pusillus* and 9.94 for *E. spinax*. The estimated parameters suggest that both species have a vulnerable life cycle, typical of deep water squalid sharks. *E. spinax* distribution patterns in terms of size, age, sex and maturity stages was found to be correlated with depth. The larger, older and mostly mature specimens occurred predominantly at greater depths, while the smaller, younger and mostly immature specimens occurred mainly at shallower depths. There seems to be a depth related migration of pregnant females between the mating grounds located in deeper waters and the nursery ground located in shallower waters. The depth distribution, catch per unit effort (CPUE), size at maturity and fecundity of *E. spinax* was compared between a population that has suffered high levels of fishing mortality during the last decades (southern Portugal in the northeast Atlantic) and a population where low fishing pressure below 500 m occurs at present or has occurred in the last decades (Alboran Sea in the western Mediterranean). The research surveys CPUE in the northeast Atlantic are substantially lower than in the Mediterranean throughout the entire depth distribution range of the species. The northeast Atlantic population matures at smaller sizes than the Mediterranean population and has a lower mean fecundity. There seem to be a presence of a density dependant mechanism in the northeast Atlantic population of *E. spinax* that has a lower size at maturity as a result of excessive fishing mortality. However, given that this is an aplacentary viviparous shark, where fecundity is dependant of female size, this compensatory mechanism seems to be less efficient than what would be expected. Mortality and demographic analyses were carried out in order to assess if the current levels of fishing mortality occurring in the south Portuguese area are sustainable. The intrinsic rates of population increase obtained for different scenarios accounting with and without fisheries mortality revealed that both lantern shark species are currently being affected by the commercial fisheries and that the populations are declining. The results of this thesis show that fishing related mortality has complex and significant repercussions on these vulnerable deep water sharks. Given the high fishing pressures that are presently occurring in the northeast Atlantic, these lantern sharks may be in danger of severe declines in the near future. Urgent conservation measurements are therefore needed.

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